ISOTOPIC ANALYSIS OF PLUTONIUM (PU) IN FOODS BY INDUCTIVELY-COUPLED PLASMA MASS SPECTROMETRY

Kathryn Emanuele, U.S. Food and Drug Administration, Winchester Engineering and Analytical Center (WEAC)

Kathryn.Emanuele@fda.hhs.gov

Zhichao Lin, Stephanie Healey, Abdur-Rafay Shareef, and Patrick Regan
U.S. Food and Drug Administration, Winchester Engineering and Analytical Center (WEAC), Winchester, MA 01890

Globalization of the food supply presents immense challenges to the U.S. Food and Drug Administration (FDA). In the aftermath of a radiological incident, the FDA needs a sensitive, rapid, and robust analytical method to quantify radioisotopes of ^{239}Pu, ^{240}Pu, and their source-term isotopic ratio in food. The isotopic ratio of ^{239}Pu/^{240}Pu identifies whether the source of contamination is from nuclear weapons, nuclear energy applications or nuclear fuel. Given the unique toxicity of Pu, any method developed for the purpose of regulatory compliance must be able to detect Pu at a concentration of below 0.67 Bq/kg which is equivalent to 1/3 of the FDA recommended derived intervention level (DIL).

Inductively-Coupled Plasma Mass Spectrometry (ICP-MS) in combination with an efficient radiochemical separation method for removing sample matrix and polyatomic interferences were used to detect Pu isotopes in food. The radiochemical separation technique involves using N,N,N',N'-tetra-n-octyldiglycolamide (DGA Resin, Normal) followed by a direct injection of the extracted Pu into the ICP-MS. A large number of samples can be run as a batch, and the method is amenable to automation.

A variety of foods including vegetable, grain, meat, dairy, and complex meal were used for method development and validation. Each food sample was spiked with known amounts of ^{239}Pu, ^{240}Pu, and ^{242}Pu, digested using a mixture of concentrated hydrogen peroxide and nitric acid, chemically purified with 1 gram of DGA resin, and analyzed for ^{239}Pu, ^{240}Pu, and ^{239}Pu/^{240}Pu ratio by ICPMS. The experimental studies demonstrate that the developed method is capable of detecting Pu in food at a concentration level below 1/3 of FDA DIL within 5 hours of receiving a sample. In this poster a detailed radioanalytical procedure, optimization of instrument parameters for Pu isotopic analysis, and the analytical results from analyzing a broad range of spiked food samples are presented.